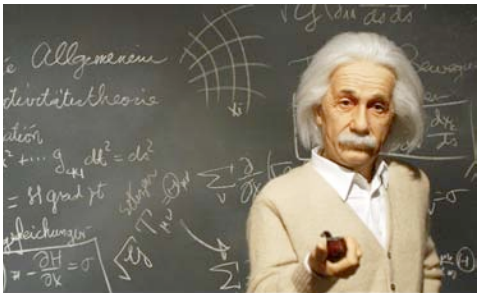

Good morning. How many of you out there would consider yourself scientists? Great – it's always good to be preaching to the choir. How many of you knew you wanted to be a scientist since you were a kid? Well you are the lucky ones. I didn't.

When I was in elementary school I wanted to be a superhero. Or a fireman or helicopter pilot. But I did have this one friend Chris Loomis. He wanted to be a scientist. And we never understood that. I mean, what was cool about being a scientist? And of course we had no idea what a scientist was (nor did Chris, I think) but we were always trying to figure out what it was that excited him.



So my friends and I would look at pictures like this and the conversation would sound something like this: I would say, "Well it looks like at least you don't have to comb your hair." Then my friend Eddie Pina would say something like, "And you get to smoke a pipe. That's good." And then there was my friend Teddy Finkleman, who would come up with something like, "Hey, it looks like you even get to wear cool sweaters." Chris did have really messy house so maybe he just really liked the idea of working in an ultra sterile lab environment.

But then I found out that Jane Goodall was a scientist. And she was hot. And she lived in Africa and studied chimpanzees.

Then I found out that George Schaller was a scientist – and he didn't just study one animal, he made his living traveling all over the world studying things like tigers and mountain gorillas and Marco Polo sheep, amazing creatures with 6 feet of horn. And he wasn't just studying these animals, he was saving them. He was documenting their status and setting up parks or sustainable hunting practices for them.

And it wasn't long before I found myself taking not only zoology and ichthyology and mammalogy but also biochemistry and statistics and experimental design. And slowly I realized that if you wanted to figure out important things like why hundreds of dolphins are dying in the Gulf of Mexico you need to work with all types of scientists – the Chris Loomis types and the George Schaller types. Geneticists, toxicologists, population dynamics experts. Fortunately this allows you to work with all types of people too – fisherman, beach watchers, marine mammal stranding volunteers

And this is how I became a scientist. It's nice that you all know that now, but that's not what brings us here today. What brings us all here today is a common sense of place – a love for a 17, 000 sq km inland sea. Whether you are a fisher, crabber, photographer, wildlife watcher, SCUBA diver, shellfish grower, ferryboat captain or a bad, bad parent like me who lets his kids take their clothes off and run naked across the beach – we're tied to this place and all of us want this place to be the best it can be.
And, if you've been paying even a little bit of attention, you'll know we have some work to do because all is not well out there.

Most of you are probably familiar with the plight of the Southern Resident Killer Whales – the most PCB-contaminated marine mammals in the world, driven toward extinction by the combined threats of live-capture for the aquarium trade in the 60's and 70's, contaminants, increased ambient noise and

decreased prey availability. But how many of you know this bird, the Western Grebe? Western Grebes used to flock in schools of thousands. It wasn't unusual to see a flock of 5,000 in Bellingham Bay, not too far from here. These birds have to have declined by over 95% over the last several decades. It's not just these 2 species. SeaDoc tracks the number of threatened or endangered species in the Salish Sea and as of last year we have 113 species listed as threatened or endangered or that are candidates for listing. If that number doesn't impress you, that's 13% of our fish species and a 1/3 of the bird and mammals.

We don't have robust finfish fisheries any more. Our biggest fisheries are for invertebrates: crab, shrimp, sea cucumber and urchin. We harvest 1 million pounds of California Sea Cucumbers. We are fishing down the food chain.

Washington has one of the largest commercial shellfish industries in the country, but at any time feces in the water closes a third of shellfish beds to harvest. All of us are responsible for non-point source pollution that dumps hydrocarbons, pesticides, herbicides, and pharmaceuticals into our marine waters.

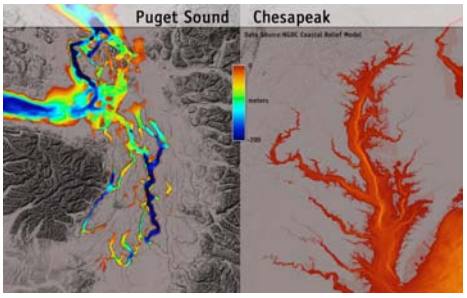
Our relationship to the ocean is changing from a place where our kids want to take their clothes off and run on the beach to a place where our relationship to the ocean is more like this. And we don't want this.

Despite the problems, this is still one of the greatest places on earth! About a decade ago, the World Wildlife Foundation named this area one of its priority conservation ecoregions in the world because of 3 important factors (and one of them wasn't the Sonics):

1. Our highly productive low and mid-level temperate forests
2. The fact that many of our marine species are unique and genetically different from those in the open ocean
3. And third because we are at the southern end of the zone that supports the greatest diversity of salmon species; not only do we have all 5 species of Pacific Salmon, we also have

steelhead (sea run rainbow trout) and sea run cutthroat as well as bull trout, which we've recently learned move into the marine waters to forage before returning up rivers.

So, we all want to save this great place. What can science do for us as we try to design a healthy Puget Sound and Salish Sea? Let's start with the basics – science tells us about what an amazing place this is. Dr. Pew, a geologist speaking here today, reminded me that Geology begets Biology so let's just start with geology – and something very basic – depth and topography. These are bathymetric maps of the Salish Sea on our left and the Chesapeake Bay on your right - using the same depth scale.




The Chesapeake Bay might be the country's largest estuary, but look at Mark Stormer's maps here and you'll see the Chesapeake is for wussies that are afraid of the deep! So what if you're the biggest estuary in the country if you're afraid to go in the deep end! You'd be hard pressed to find a place in the Chesapeake deeper than 60 feet. Heck, on most of Puget Sound shorelines a 3rd grader could throw a rock from shore and it would sink deeper than 60 ft. Our average depth in Puget sound is about 200 feet and the deepest part of the Salish Sea, Bute Inlet, is almost 2000 feet deep.

Now if geography begets biology and we have depth, topography and current working on our side to create a place for cool animals and Puget Sound owns the cool animal show. I'm not talking charismatic mega vertebrates – let's start with the invertebrates. We have the North Pacific Giant Octopus, the largest octopus in the world. The giant pacific chiton, also the largest of the world's chitons, growing to almost a ½ of a meter long. The Giant barnacle –also the largest barnacle in the world growing to 15 cm across and 30 cm tall. Or this Plumose Anemone (*Metridium senile*), the largest Sea Anemone, which can grow to be over ½ a meter long.

And I already said that we are known for our salmon, but science tells us that we also have about 250 other species of marine and anadramous fish species in the area. And it's science that tells us that

we have an unusually high number of fishes that are considered long-lived, which for fish is about 30-years. In fact, many of the fish species we have can live to be over 100 years old. That means we have spiny dogfish swimming around out there that were born when Woodrow Wilson was president. And it's science that tells us that yellow eye rockfish can live to be 118 years old. And science that tells us that you can collect one of the demersal rockfish, (demersal is science speak for "hang out and don't go nowhere homeboy rockfish cause you stay on a single reef for your entire life), transport it miles away, tag it and 2 days later it'll be back on that same rocky reef where it's lived the last 75 years of its life.

Most of you know this bird by sight and probably by call – right – a bald eagle. But it's SCIENCE that tells us you can judge the magnitude of a salmon run on a river by the number of eagles on the shore.
Also, it's science that tells us we have over 170 other species of birds that depend on the marine ecosystem. And it's science that tells us that we have some birds that you might never associate with the marine ecosystem like the Snowy Owl. Science also tells us when and where we can expect to see cool birds like the Snowy Owl that come to the Salish Sea to hunt our seabirds and ducks.

Any of you ever see these guys while you're out kayaking? Not as common as the harbor seal, but we are seeing more and more of these northern elephant seals as the population grows. You guessed it, science taught us that these guys can use every inch of the Salish Sea right down to 2000, the deepest point at Bute Inlet in BC. How do we know that? You see there are things called time-depth recorders. I don't have a picture of one on an elephant seal, but here's one that we put on a harbor seal.

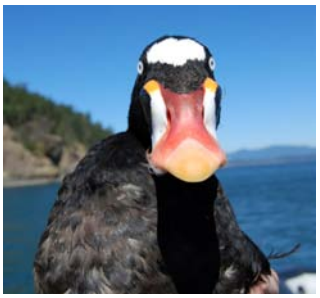
The first time scientists put one of these on an elephant seal it came back crumpled like a car had run over it. You see, most animals in the ocean live near the surface. Like all good scientists the mystery excited them. They re-engineered the TDR, glued it on another elephant seal and found that these animals can dive to nearly a mile deep. Cool fact – thanks to science.

Okay, so science tells us cool things about the ecosystem. That's good because we need to be inspired to want to Save Puget Sound…I mean we all know it is important economically, spiritually, ethically etc to save Puget Sound, but everybody doesn't and we need ways to inspire them to care. You see,

despite knowing that fixing the ecosystem is good, the market does not currently support ecosystem restoration. Let's talk about what the market does support: Football. I don't care if you're a football fan or not, none of you will argue that we need ways to inspire people to care about the super bowl – you don't hear people saying "Hey we need to really improve coverage so people will watch on Sunday." Estimates are that probably 100 million people will tune in tomorrow – that's one in every 3 people in America - You see, markets support the NFL and the super bowl. People watch it and pay money to watch it.

Unlike football, markets don't always support things like ecosystem restoration even though we know healthy ecosystems translate to more jobs, healthier lifestyles and a future we'd all elect for our kids if given the choice. But remember, people also know that eating Doritos and chicken wings, sitting on the couch and drinking beer and watching TV is not good for their health but there will be close to 100 million people doing this tomorrow. You see, we don't always put our money or our actions where we know it is best for the greater good. Often we need to be encouraged to do that.

There's a reason people in the US smoke less and wear their seatbelts more, and it's not because the global market demanded this. It's because people did some really good science showing that these things were costing us all plenty, then they did some great social marketing to make people understand that we all could live longer if we paid attention and quit smoking and wore our seatbelts. I mean, now what's the first thing you do when you get in the car – put on the seatbelt. And it is so rare to have somebody light up during dinner now and if somebody does light up, we flip out. "What do you think you're doing, this isn't France man, you can't smoke in here." Then finally, we also passed some laws to make sure they happened because we can't always depend on people to do the right thing. Sometimes we have to legislate. This is what we need to do for Puget Sound.



So, beyond telling us cool things about the ecosystem to inspire us, science also can help us manage the ecosystem. Let's take a rather straightforward example. Everybody know this bird? Surf Scoter…Here's a science question that was posed to us a few years ago: What's the probability that current

Scoter hunting is impacting the long-term sustainability of the scoter population in Puget Sound? Well, science tells us cool things about Surf Scoters – they can live to be 16 years old and are what biologists call K-selected meaning they depend on high adult survival. They're not like deer, they don't breed successfully every year and unlike deer, you can't harvest nearly half of the population annually and keep the population stable. We also know, thanks to satellite and VHF implanted transmitters, that when they settle down in a region of Puget Sound for the winter they stay there. This is called high site fidelity. So, SeaDoc funded scientists at WDFW to analyze hunter harvest data, and Yes – the data from hunter harvest and data on site fidelity told us that in 4 counties we have been shooting more scoters than the population can sustain. Using this science, managers have decided to change the daily harvest rate and a line has been drawn in the sand to stop all hunting if the population sinks to below 55,000 birds.

Here's another example where science can help management. These are Pacific White-sided dolphins. Let's ask another management question…is the incidental by-catch of Pacific White-sided dolphins impacting the long-term sustainability of the population? Well, to evaluate this we first need to know the parameters of the population. This includes size of the population, age and sex structure, reproductive capacity, etc. From this we can calculate what biologists call PBR or the potential biological removal. Next we need to have a good estimate for the number of animals being accidentally caught in fishing nets and we can compare that to the calculated PBR. A few years ago SeaDoc funded Dr. Rob Williams to do this on the Canadian side of the border where they don't have the laws that require them to do this as we do in the US. Guess what? There is evidence suggesting that the current level of bycatch could be impacting the population.

Have fishing laws changed to protect them? No. And this is a good reminder that science doesn't equal policy. Science provides data that managers and policy makers can use to make decisions.

Here's another example. Now most of you are familiar with seagrasses and their importance, right? Okay – excellent – they provide spawning sites for herring, nursery sites for juvenile fishes, structure for

organisms like brooding anemones. So eelgrass is good. And we have many places where eelgrass is declining. Can science tell us how many miles of eelgrass we need in Puget Sound? No, it can't. You see that is a policy question. BUT, science can help policy makers answer that question by providing them with data and scenarios that they then can use to make their decision. Science also can tell us the sensitivity of our ability to measure eelgrass meadows. For example, with the monitoring conducted by DNR, we know that we can't detect less than a 20% change – either up or down. That's important because that means we should even bother setting targets for recovery less than 20% increase, because we can't detect that.

Okay – so let's move on to another concept. Science can tell us cool things about our ecosystem, it can provide important data that support management and policy decisions, and it can help us determine where to put time and money to restore Puget Sound. It's pretty clear this guy needed to invest more in a navigation class and a chart or maybe even a GPS unit for his boat.

Regarding Puget Sound, science tells us not only what is important to do, but also how we can prioritize those actions. How do we know what is important to do to restore the ecosystem? Science tells us. Let's just use an example from the health field. Let's say you're thinking about your health and you go to the doctor – what are they going to tell you? Well they're going to tell you to cover your mouth when you sneeze for one. Seriously, I apologize for this image, it's kind of gross. I really wanted to talk about heart attacks but do you know how hard it is to find a picture of a person having a heart attack? And maybe that's a good thing- if you're having one you don't want your friends to be taking pictures. Can't you see it? You say, "Hey, uh, I think I'm having the big one here!" And your friend responds, "Oh man, you look so funny, let me just run and get my camera, then I'll call 911."

So you tell the doctor that you don't want to have a heart attack and ask her, "Should I quit smoking, stop drinking, start exercising or start eating better?" and the doctor will say – because she was schooled taking multiple choice tests – D. All of the above. But the doctor won't say oh, and stop wearing spandex. You see, while it might be a really good idea to stop wearing spandex (for many

reasons), it's not a risk factor for heart attacks. All the other ones are scientifically calculated risk factors for heart attacks. Because of science we can even tell you that the risk factors of smoking, high blood pressure, elevated blood glucose and obesity currently reduce life expectancy in the U.S. by 4.9 years in men and 4.1 years in women.

So just like human epidemiology can tell us what is important to do for our own health, science also can tell us what to do for the ecosystem. It can even help us prioritize where we put our time and money into restoration. What is our priority for Puget Sound? Scientifically we can't tell you. We have a lot of good ideas, but remember that ideas and opinions are not science. Right now we still need to conduct a risk assessment for Puget Sound. This needs to be spatially explicit because issues in King County are not the same as the issues in Island County. And when that project is done, we should be able to better say "these are the top stressors and threats in these areas and this is where we'd be better off making our investment." Right now we are conducting what some call a thousand random acts of kindness. Everything we are doing is important, but we haven't yet been able to prioritize it. That will come.

So we've spoken a little about what we can expect science to do and to not do. Now I want to spend a little time talking about pitfalls to avoid. First I want to show you a little video to make a point:
See: Danny MacAskill's Industrial Revolutions (http://www.youtube.com/watch?v=ShbC5yVqOdI)
Now I know you're thinking, man that was wicked cool…that guy is sick - right? And I know you're also thinking why did Joe show us that. Well how many of you think that Danny MacAskill just woke up one morning and was able to do that? Or better yet, that is father and some friends were sitting around drinking a pint and his dad said, "Hey Danny, me and the boys was thinking you should take that there bike and go down and ride atop them old railway cars and when ya gets to the end – just jump off like that?" No – even after a bunch of pints nobody would tell their kid that. What you just saw took time and effort, before the fact!

Science is like Danny MacAskill's sick trick riding. The work must be frontloaded before the execution. Do you think that video I just showed you was the first time that Danny MacAskill ever did any of those tricks? No way. Just like exercise or cool tricks, the time to do science is ahead of when you need it. This is a difficult concept

in today's culture of immediate gratification where you can just Google anything. Hey Joe, where's the best place to put that $30 million we just got from EPA to restore Puget Sound? "Uh, give me a minute and let me Google that." That's not how science works.

The science needs to be done BEFORE you need it. Unfortunately most people don't understand that and consequently come away with the feeling that science is slow or that scientists just want to study everything to death.

The next pitfall to avoid is the collection of non-quality data. If your data are not collected in a robust enough manner that will be suitable for publication, then you need to ask yourself if you should even be collecting those data. My friend Dan Mulcahy, a brilliant USGS scientist in Alaska, always says, "If you don't publish your data you're not a scientist, just a person with an interesting hobby."

Remember, people need to be able to understand how the data were collected, analyzed and interpreted. That is what permits then to understand the significance and that is what peer-review is about. Right now we have State agencies filled with outstanding scientists, but some of the agencies don't reward publication. That is a major loss to not reward this critical step.

This standard applies to all science, even citizen-driven science. I am a big fan of citizen science and I also believe it must withstand the same rigors of all scientific endeavors. Fortunately there are numerous citizen-science efforts in the region that hold these high standards – REEF environmental education foundation's SCUBA surveys, COASST's beached bird survey work, Audubon's Christmas Bird Count, Dan Pentilla's Forage Fish beach survey work... All of these examples produce data that are quality controlled and used in peer-reviewed publications.


The next step is just as critical as the others – share! Science must be shared. The job of the scientist is no longer over when the publication comes out. Science needs to be shared with the general public. It needs to be used to educate them and inspire them. Also it needs to be shared with managers and policy makers in a format that they can understand and use. How many peer-reviewed publications to you think Governor Gregoire has read in the last year? I think not many. That's not

because she's not brilliant and wouldn't understand it, it's just because that's not the medium by which policy makers communicate.

In Michael Specter's book entitled *Denialism*, he theorizes that "our scientific capabilities have brought the world to a point where we expect miracles, but have lost faith in those capable of producing them," the scientists themselves. As a collective group, we as scientists are partially to blame for the fact that people don't understand what science is and don't have faith in science and we need to see ourselves (scientists) as part of the solution. People get their information from places other than where most scientists put our information. Consequently our information often is not getting heard or used or believed. This creates sort of a scientific vacuum in a world of information overload where anybody can put up a website and claim to be an expert but we the scientists with the data are not participating.

We need to do better.

Science is cool. It tells us cool things about our ecosystem and wildlife that give us a sense of place, fascinate us and inspire us to care. Remember this, because ecosystem restoration is not supported by the forces of the global market and it's our job to help people to care and to understand that this is not just about hugging whales – it's about jobs, quality of life and securing a natural support system that provides us with clean food and water. Science also can help improve management decisions – it doesn't decide for us but it supports management and policy decisions.

Also, in these challenging economic times, it is important for us to remember that science can help tell us how to spend our time and resources wisely. But remember, none of this is possible if we don't remember that science is front-loaded. Just as you need to begin exercising months before you want to run a marathon, we need to be conducting science long before we need to use it. Also, even before we begin collecting data, we need to be sure that we have a valid study design and that our sampling effort is robust enough to address our hypothesis. And when the project is over, we need to publish our findings. And finally we need to share our findings with the educators and outreach people so they can use them to inspire people, and with the managers and policy makers so they can incorporate those data into their decisions.

I really like this picture my friend Scott White, a small town boy from the Piedmont of Virginia, took when he was out here visiting me and my family last year. When he first showed it to me he didn't say, "You've got to see this awesome shot I got of a salmon heading upstream." No, he said, "You know Joe, sometimes I feel like this." And you know what, right now we are salmon swimming upstream. Designing a healthy Puget Sound and Salish Sea is a HUGE and complicated task and it won't be easy.

Bill Ruckelshaus often says, "If it were easy, we would have already done it." But the job is so important that failure is not an option. We are fortunate to have a governor who cares. We are fortunate to have the Puget Sound Partnership. We are lucky to have the Tribes as allies and we are lucky to have all of you, because right here in this room you represent the collective greatness of what we have going for us…people who care enough to dedicate themselves to making it happen.Science is and will continue to be a crucial part of restoring this ecosystem. We just need to understand the role that it plays, use it wisely, not expect it to do more than it can and empower it with support and funding.

Thank you all for taking time out of your busy lives to be here today. I consider you all allies in this massive undertaking so let's work together and get 'er done!

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